COURSE SCHEME
EXAMINATION SCHEME
ABSORPTION SCHEME
&
SYLLABUS

Of

First, Second, Third & Fourth Semester
Choice Base Credit System (CBCS)
Of
Master of Technology (M.Tech)

In
Electronics

Of
RASHTRASANT TUKDOJI MAHARAJ
NAGPUR UNIVERSITY, NAGPUR

Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur
Faculty of Engineering & Technology
Course and Examination Scheme of Master of Technology
Choice Base Credit System(CBCS)

I Semester M. Tech. (Electronics)

Subject Code	Subject	Teaching Scheme			Examination Scheme								
					Theory					Practical			
		Hours per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			University Assessment	College Assessment			University Assessment	College Assessment		
PGETX101T	Advanced Digital Signal Processing	4	-	4	3	70	30	100	50	-	-	-	-
PGETX102T	High Speed Semiconductor Devices and Circuits	4	-	4	3	70	30	100	50	-	-	-	-
PGETX103T	Advanced Embedded System Design	4	-	4	3	70	30	100	50	-	-	-	-
PGETX104T	Elective-I	4	-	4	3	70	30	100	50	-	-	-	-
PGOPEN105T	Elective-II (Open)	4	-	4	3	70	30	100	50	-	-	-	-
PGETX106P	Laboratory -I Advanced Digital Signal Processing	-	2	1	-	-	-	-	-	50	50	100	50
PGETX107P	Laboratory -II Advanced Embedded System Design	-	2	1	-	-	-	-	-	50	50	100	50
Total		20	4		-	350	150	500	-	100	100	200	-
Semester Total		24		22	700 Marks								

Elective-I (Discipline Specific): 1. Pattern Recognition[PGETX104/1T] 2. Analog IC Design[PGETX104/2T] 3. Advanced Digital Communication[PGETX104/3T]
Elective-II (Open): List of Open Elective-II [PGOPEN105T] is enclosed.

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II Semester M. Tech. (Electronics)

Subject Code	Subject	Teaching Scheme			Examination Scheme								
					Theory					Practical			
		Hours per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			University Assessment	College Assessment			University Assessment	College Assessment		
PGETX201T	Digital System Modeling and Simulation	4	-	4	3	70	30	100	50	-	-	-	-
PGETX202T	High Performance Communication Networks	4	-	4	3	70	30	100	50	-	-	-	-
PGETX203T	Advanced System Design	4	-	4	3	70	30	100	50	-	-	-	-
PGETX204T	Elective-III	4	-	4	3	70	30	100	50	-	-	-	-
PGFD205T	Foundation-I	4	-	4	3	70	30	100	50	-	-	-	-
PGETX206P	Laboratory -I Digital System Modeling and Simulation	-	2	1	-	-	-	-	-	50	50	100	50
PGETX207P	Laboratory -II Advanced System Design	-	2	1	-	-	-	-	-	50	50	100	50
Total		20	4		-	350	150	500	-	100	100	200	-
Semester Total		24		22	700 Marks								

Elective-III: 1.Fault Tolerance in Digital Circuits [PGETX204/1T] 2. Advanced Digital Image Processing [PGETX204/2T] 3. Mobile Communication [PGETX204/3T]
4. Advanced Communication Technologies [PGETX204/4T]

Foundation-I: Research Methodology

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III Semester M. Tech. (Electronics)

Subject Code	Subject	Teaching Scheme			Examination Scheme								
					Theory					Practical			
		Hours per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			University Assessment	College Assessment			University Assessment	College Assessment		
PGOPEN301T	Elective-IV (Open)	4	-	4	3	70	30	100	50	-	-	-	-
PGFD302T	Foundation-II	4	-	4	3	70	30	100	50	-	-	-	-
PGETX303P	Project Seminar	-	8	8	-	-	-	-	-	-	200	200	100
Total		8	8		-	140	60	200	-	-	200	200	-
Semester Total		-		16	400 Marks								

Elective-IV (Open): List of Open Elective-IV [PGOPEN301T] is enclosed.

Foundation-II: Project Planning and Management

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IV Semester M. Tech. (Electronics)

Subject Code	Subject	Teaching Scheme			Examination Scheme								
					Theory					Practical			
		Hours per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			University Assessment	College Assessment			University Assessment	College Assessment		
PGETX401P	Project	-	16	16	-	-	-	-	-	400	-	400	200
Total		-	16		-	-	-	-	-	400	-	400	-
Semester Total		-		16	400 Marks								

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Absorption Scheme of Master of Technology

Choice Base Credit System (CBCS)

I Semester M. Tech. (Electronics)

S.N.	Code	Semester Subject Name	New Subject Code	CBCS Subject Name
1.	IFU03	Advanced Digital Signal Processing(Th)	PGETX101T	Advanced Digital Signal Processing
2.	----------	----------	PGETX102T	High Speed Semiconductor Devices and Circuits *
3.	----------	----------	PGETX103T	Advanced Embedded System Design*
4.	IIFU05(A)	Pattern Recognition(Th)	PGETX104T/1T	Elective-I : Pattern Recognition
5.	IIFU05(B)	Analog VLSI Design(Th)	PGETX104T/2T	Elective-I : Analog IC Design
6.	IFU01	Digital Communication(Th)	PGETX104T/3T	Elective-I : Advanced Digital Communication
7.	----------	----------	PGOPEN105T	Elective-II (Open) : Biomedical Systems Engineering *
8.	IFU04	Fuzzy Logic & Neural Networks(Th)	PGOPEN105T	Elective-II (Open) : Soft Computing Techniques
9.	----------	----------	PGOPEN105T	Elective-II (Open) : Digital Forensics *
10	----------	----------	PGOPEN105T	Elective-II (Open) : Nano Electronics *
11.	IFU03	Advanced Digital Signal Processing(P)	PGETX106P	Laboratory -I Advanced Digital Signal Processing
12.	----------	----------	PGETX107P	Laboratory -II Advanced Embedded System Design *
13.	IFU02	VLSI Circuits(Th)	----------	----------
14.	IFU02	VLSI Circuits(P)	----------	----------
14.	IFU05	Programming & Data Structures(Th)	----------	----------
15.	IFU03	Programming & Data Structures(P)	----------	----------

The students who fail to clear any subject(s) of the I Semester Old Pattern by the last chance prescribed, shall be required to clear the respective equivalent subject of I Semester(New CBCS Pattern) along with the additional subject marked with (*). The Theory and Practical College and University Assessment Marks of Old Pattern will be converted into the same proportion in New CBCS Pattern. The College Assessment Marks of the Additional Theory/Practical Subject marked with (*) will be taken in same proportion of the average College Assessment Marks in all the Theory/Practical subject of old pattern.

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II Semester M. Tech. (Electronics)

The students who fail to clear any subject(s) of the II Semester Old Pattern by the last chance prescribed, shall be required to clear the respective equivalent subject of II Semester(New CBCS Pattern) along with the additional subject marked with (*). The Theory and Practical College and University Assessment Marks of Old Pattern will be converted into the same proportion in New CBCS Pattern. The College Assessment Marks of the Additional Theory/Practical Subject marked with (*) will be taken in same proportion of the average College Assessment Marks in all the Theory/Practical subject of old pattern.

S.N.	Code	Semester Subject Name	New Subject Code	CBCS Subject Name
1.	----------	----------	PGETX201T	Digital System Modeling and Simulation *
2.	IIFU03	Data Communication(Th)	PGETX202T	High Performance Communication Networks
3.	----------	----------	PGETX203T	Advanced System Design *
4.	----------	----------	PGETX204T/1T	Elective-III: Fault Tolerance in Digital Circuits *
5.	IIFU02	Digital Image Processing(Th)	PGETX204T/2T	Elective-III: Advanced Digital Image Processing
6.	IIIFU03(C)	Mobile Communication(Th)	PGETX204T/3T	Elective-III: Mobile Communication
7.	----------	----------	PGFD205T	Foundation-I: Research Methodology*
8.	----------	----------	PGETX206P	Laboratory -I Digital System Modeling and Simulation *
9.	----------	----------	PGETX207P	Laboratory -II Advanced System Design *
10.	IIFU01	Digital System Design(Th)	----------	----------
11.	IIFU01	Digital System Design(P)	----------	----------
12.	IIFU02	Digital Image Processing(P)	----------	----------
13.	IIFU04	Microcontroller & Their Applications(Th)	----------	----------
14.	IIFU04	Microcontroller & Their Applications(P)	----------	----------
15.	IIFU05(C)	Computer Graphics(Th)	----------	----------

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III Semester M. Tech. (Electronics)

S.N.	Code	Semester Subject Name	New Subject Code	CBCS Subject Name
1.	----------	----------	PGOPEN301T	Elective-IV (Open): Wireless Sensor Network *
2.	----------	----------	PGOPEN301T	Elective-IV (Open): Bio-Informatics *
3.	----------	----------	PGOPEN301T	Elective-IV (Open): Artificial Intelligence and Robotics *
4.	----------	----------	PGFD302T	Foundation-II: Project Planning and Management *
5.	IIIFU03	Project Seminar	PGETX303P	Project Seminar
6.	IIIFU01	Parallel Processing and Algorithms(Th)	----------	----------
7.	IIIFU02(A)	Programmable Devices and Testing(Th)	----------	----------
8.	IIIFU03(B)	IP Core and RTOS(Th)	----------	----------

The students who fail to clear any subject(s) of the III Semester Old Pattern by the last chance prescribed, shall be required to clear the respective equivalent subject of III Semester(New CBCS Pattern) along with the additional subject marked with (*). The Theory and Practical College and University Assessment Marks of Old Pattern will be converted into the same proportion in New CBCS Pattern. The College Assessment Marks of the Additional Theory/Practical Subject marked with (*) will be taken in same proportion of the average College Assessment Marks in all the Theory/Practical subject of old pattern.

R.T.M. Nagpur University
Scheme of Examination for
M. Tech. (Electronics) First Semester

PGETX101T	Advanced Digital Signal Processing

Course Objectives:

1. To study the basic concepts of digital signal processing.
2. To study analysis and processing of signals for different kind of applications and retrieval of information from signals.
3. To study designing of digital filters and its realization.
4. To study analysis of signals using the discrete Fourier transform (DFT) and Z-Transform.
5. To Study Power Spectrum Estimation.
6. To study the application of Wavelet Transforms.

Course Outcome: By the end of the course the students shall be able to:

1. Represent discrete-time signals analytically and visualize them in the time domain.
2. Meet the requirement of theoretical and practical aspects of DSP with regard to sampling and reconstruction.
3. Design and implement digital filter for various applications.
4. Estimation of Power Spectrum
5. Describe the concept of multi rate signal processing and how to apply it for the wavelet transform.
6. Describe the various transforms for analysis of signals and systems.

UNIT I: Multirate Digital Signal Processing: (9)

Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I/D, Filter Design and Implementation for sampling rate Conversion Multirate Digital Signal Processing Multistage, Implementation of Sampling Rate Conversion, Applications of Multirate Signal Processing, Sampling Rate Conversion of Bandpass Signals Linear Prediction and Optimum Linear

UNIT II: Filters: (8)

Innovations Representation of a Stationary Random Process, Forward and Backward Linear Prediction, Solution of the Normal Equations, Properties of linear prediction - Error Filter, AR Lattice and ARMA Lattice-Ladder Filters.

UNIT III: Power Spectral Estimation: (9)

Estimation of Spectra from Finite Duration Observations of a signal, the Periodogram, Use DFT in power Spectral Estimation, Bartlett, Welch and Blackman, Tukey Methods, Comparison of performance of Non-Parametric Power Spectrum Estimation Methods

UNIT IV: Parametric Method of Power Spectrum Estimation: (10)

Parametric Methods for power spectrum estimation, Relationship between Auto-Correlation and Model Parameters, AR (Auto-Regressive) Process and Linear Prediction, Yule-Walker, Burg and Unconstrained Least Squares Methods, Sequential Estimation, Moving Average(MA) and ARMA Models Minimum Variance Method, Piscaranko's Harmonic Decomposition Methods, MUSIC Method.

UNIT V: (8)

Window Selection, Wavelet Transform, STFT to Wavelet conversion, Basic Wavelet, Discrete time orthogonal Wavelet, Continuous Time Orthogonal Wavelets

TEXT BOOKS:

1. Proakis JG and Manolakis DG Digital Signal Processing Principles, Algorithms and Application, PHI.

2. Openheim AV & Schafer RW, Discrete Time Signal Processing PHI.

REFERENCE BOOKS:

1. Samuel D Stearns, "Digital Signal Processing with examples in Matlab. " CRC Press.

2. ES Gopi. "Algorithm collections for Digital Signal Processing Applications using Matlab", Springer.

3. Taan S.Elali, "Discrete Systems and Digital Signal Processing with Matlab, " CRC Press,2005.

PGETX102T	High Speed Semiconductor Devices and Circuits

Course Objectives:

1. To study crystal structure of Semiconductors.
2. To study different MOS devices and their characteristics.
3. To study Advanced Devices HBT and HEMT Devices
4. To study the fabrication process in detail.
5. To study different MOS Integration Techniques.

Course Outcome: By the end of the course the students shall be able to:

1. Identify different MOS devices for the specific application.
2. Fabrication of different MOS devices corresponding to the requirements.
3. Integrate different MOS devices.

UNIT I: Review of Crystal Structure: (9)

Crystal structure of important semiconductors (Si, GaAs, InP), electrons in periodic lattices, energy band diagram, carrier concentration and carrier transport phenomenon, electrical, optical, thermal and high field properties of semiconductors, Homojunction Devices, Homojunction Devices (BJT and FET): Structure, band diagram, operation, I–V and C–V characteristics (analytical expressions), small signal switching models.

UNIT II: MOS Devices: (9)

MOS Diode: Structure, band diagram, operation, C–V characteristics, effects of oxide charges, avalanche injection, high field effects and breakdown; Heterojunction Based MOSFET: Band diagram, structure, operation, I–V and C–V characteristics (analytical expressions), MOSFET breakdown and punch through, subthreshold current, scaling down; Alternate High k-dielectric Materials: HF–MOSFETs - SOI MOSFET - buried channel MOSFET - charge coupled devices.

UNIT III: Advanced Devices HBT and HEMT Devices: (8)

AlGaAs/ GaAs, InP and SiGe based HBT and HEMT structure, band diagram, operation, I–V and C–V characteristics (analytical expressions), small signal switching models, benefits of heterojunction transistor for high speed applications.

UNIT IV: (9)

Fabrication and Characterization Techniques Crystal Growth and Wafer Preparation: Epitaxy, diffusion, ion implantation, dielectric film deposition and oxidization techniques, masking and lithography techniques (optical, e-beam and other advanced lithography techniques), metallization

UNIT V: (9)

Bipolar and MOS integration techniques, interface passivation techniques; Characterization Techniques: Four probe and Hall Effect measurement, I–V and C–V for dopant profile characterization and DLTS.

TEXT BOOKS:

1. High Speed Semiconductor Devices , S.M.Sze, Willey, 1990
2. Nandita Das Gupta and Amitava Das Gupta, “Semiconductor Devices: Modeling and Technology”, Prentice Hall of India, 2004.

REFERENCE BOOKS:

1. M. S. Tyagi, “Introduction to Semiconductor Materials and Devices”, John Wiley and Sons, 2008.
2. J. Singh, “Semiconductor Devices: Basic Principles”, John Wiley and Sons, 2007.

PGETX103T	Advanced Embedded System Design

Course Objectives:

1. To expose the students to the fundamentals of embedded system design.
2. To enable the students to understand and use embedded computing platform.
3. To introduce networking principles in embedded devices.
4. To introduce RTOS in embedded devices.

Course Outcome: By the end of the course, the students shall be able

1. Able to select and design suitable embedded systems for real world applications.
2. Able to embed different components as the application.

UNIT I: Embedded Processors
(10)

Embedded Computers, Characteristics of Embedded Computing Applications, Challenges in Embedded Computing system design, Embedded system design process- Requirements, Specification, Architectural Design, Designing Hardware and Software Components, System Integration, Formalism for System Design- Structural Description, Behavioural Description, Design Example: Model Train Controller, ARM processor- processor and memory organization.

UNIT II: Embedded Processor and Computing Platform (10)

Data operations, Flow of Control, SHARC processor- Memory organization, Data operations, Flow of Control, parallelism with instructions, CPU Bus configuration, ARM Bus, SHARC Bus, Memory devices, Input/output devices, Component interfacing, designing with microprocessor development and debugging, Design Example : Alarm Clock. Hybrid Architecture

UNIT III: Networks (8)

Distributed Embedded Architecture- Hardware and Software Architectures, Networks for embedded systems- I2C, CAN Bus, SHARC link supports, Ethernet, Myrinet, Internet, Network-Based design- Communication Analysis, system performance Analysis, Hardware platform design, Allocation and scheduling, Design Example: Elevator Controller.

UNIT IV: Real-Time Characteristics (8)

Clock driven Approach, weighted round robin Approach, Priority driven Approach, Dynamic Versus Static systems, effective release times and deadlines, Optimality of the Earliest deadline first (EDF) algorithm, challenges in validating timing constraints in priority driven systems, Off-line Versus Online scheduling.

UNIT V: System Design Techniques **(8)**

Design Methodologies, Requirement Analysis, Specification, System Analysis and Architecture Design, Quality Assurance, Design Example: Telephone PBX- System Architecture, Ink jet printer- Hardware Design and Software Design, Personal Digital Assistants, Set-top Boxes.

TEXT BOOKS:

1. Frank Vahid and Tony Givargis, "Embedded System Design: A Unified

2. Hardware/Software Introduction", John Wiley & Sons.

REFERENCE BOOKS:

1. Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design",

   Morgan Kaufman Publishers.

2. Jane.W.S. Liu, "Real-Time systems", Pearson Education Asia.

3. C. M. Krishna and K. G. Shin, "Real-Time Systems" , McGraw-Hill, 1997

Elective-I (Discipline Specific):

PGETX104/1T	Pattern Recognition

Course Objectives:

1. To provide the student with an extensive and thorough insight into pattern recognition.
2. To make student familiar with general approaches such as Bayesian Classification, Nearest Neighbour Rule.
3. To study different types of classifiers.
4. To study different clustering techniques.

Course Outcome: By the end of the course, the students shall be able to

1. Formulate and describe various applications in pattern recognition.
2. Mathematically derive, construct, and utilize Bayesian-based classifiers and non-Bayesian classifiers both theoretically and practically.
3. Identify the strengths and weaknesses of different types of classifiers.
4. Validate and assess different clustering techniques
5. Understand the possibilities and limitations of pattern recognition

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UNIT I: Introduction: **(9)**

Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches, Mathematical foundations – Linear algebra, Probability Theory, Expectation, mean and covariance, Normal distribution, multivariate normal densities, Chi squared test.

UNIT II: **(8)**

Statistical Patten Recognition: Bayesian Decision Theory, Classifiers, Normal density and discriminant functions

UNIT III: **(9)**

Parameter estimation methods: Maximum-Likelihood estimation, Bayesian Parameter estimation, Dimension reduction methods - Principal Component Analysis (PCA), Fisher Linear discriminant analysis, Expectation-maximization (EM), Hidden Markov Models (HMM), Gaussian mixture models.

UNIT IV: **(9)**

Nonparametric Techniques: Density Estimation, Parzen Windows, K-Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy classification.

UNIT V: **(9)**

Unsupervised Learning & Clustering: Criterion functions for clustering, Clustering Techniques: Iterative square - error partitional clustering – K means, agglomerative hierarchical clustering, Cluster validation.

TEXT BOOKS:

1. Bishop, C. M.Pattern Recognition and Machine Learning. Springer. 2007.
2. Marsland, S.Machine Learning: An Algorithmic Perspective. CRC Press. 2009.
3. Theodoridis, S. and Koutroumbas, K.Pattern Recognition. Edition 4. Academic Press, 2008.
4. Russell, S. and Norvig, N.Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence. 2003.
5. Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995.
6. Hastie, T., Tibshirani, R. and Friedman, J.The Elements of Statistical Learning. Springer. 2001.
7. Koller, D. and Friedman, N.Probabilistic Graphical Models. MIT Press. 2009.

REFERENCE BOOKS:

1. Richard O. Duda, Peter E. Hart and David G. Stork, "Pattern Classification", 2 nd Edition,John Wiley, 2006.
2. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2009.
3. S. Theodoridis and K. Koutroumbas, "Pattern Recognition", 4 th Edition, Academic Press,2009.

Elective-I (Discipline Specific):

PGETX104/2T	Analog IC Design

Course Objectives:

1. To lay good foundation on the design and analysis of CMOS analog integrated circuits.
2. To study Modeling of CMOS Devices.
3. To study Analog IC Design theory and practical design methodology.

Course Outcome: By the end of the course, the students shall be able to

1. Design different Analog circuits.
2. Analyze the model parameters of integrated circuits.

UNIT I: MOS Devices and Modeling: (9)

The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modeling - Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model.

UNIT II: Analog CMOS Sub-Circuits: (9)

MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors- Current mirror with Beta Helper, Degeneration, Cascade current Mirror and Wilson Current Mirror, Current and Voltage References, Band gap Reference.

UNIT III: CMOS Amplifiers: (8)

Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures.

UNIT IV: CMOS Operational Amplifiers: (9)

Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power-Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of Op Amp.

UNIT V: Comparators: (9)

Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.

TEXT BOOKS:

1. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.
2. Analysis and Design of Analog Integrated Circuits- Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Wiley India, Fifth Edition, 2010.

REFERENCE BOOKS:

1. Analog Integrated Circuit Design- David A. Johns, Ken Martin, Wiley Student Edn, 2013.
2. Design of Analog CMOS Integrated Circuits- Behzad Razavi, TMH Edition.
3. CMOS: Circuit Design, Layout and Simulation- Baker, Li and Boyce, PHI.

Elective-I (Discipline Specific):

PGETX104/3T	Advanced Digital Communication

Course Objectives:

1. To study basic components of digital communication.
2. To understand the digital representation of signals.
3. To study the different modulation techniques.
4. To study the designing of digital communication systems.

Course Outcome: By the end of the course, the students shall be able to

1. Describe and analyze the Digital Transmission of Signals.
2. Describe the effective digital modulation techniques as per the applications.
3. Model digital communication systems using appropriate mathematical techniques.

UNIT-I: **(8)**

Digital Transmission Fundamentals: Digital Representation of Information: Block-Oriented Information, Stream Information; Why Digital Communications? Comparison of Analog and Digital Transmission, Basic properties of Digital Transmission Systems; Digital Representation of Analog Signals: Bandwidth of Analog Signals, Sampling of an Analog Signal, Digital Transmission of Analog Signals; Characterization of Communication Channels: Frequency Domain Characterization, Time Domain Characterization

UNIT-II: **(9)**

Fundamental Limits in Digital Transmission: The Nyquist Signaling Rate, The Shannon Channel Capacity; Line Coding; Modems and Digital Modulation: Binary Phase Modulation, QAM and Signal Constellations, Telephone Modem Standards; Properties of Media and Digital Transmission Systems: Twisted Pair, Coaxial Cable, Optical Fiber, Radio Transmission, Infrared Light; Error Detection and Correction: Error Detection, Two Dimensional Parity Checks, Internet Checksum, Polynomial Codes, Standardized Polynomial Codes, Error Detecting Capability of a Polynomial Code.

UNIT-III: **(9)**

Brief Review of digital communication systems: Elements of Digital communication systems; Communication channels and their characteristics; Historical perspective in the development of digital communication; Review of the features of a decreases memoryless channel and the channel capacity theorem

UNIT-IV: **(9)**

Waveform Coding Techniques: PCM, Channel. Noise and error probability, DPCM, DM, coding speech at low bit rates, Applications.

UNIT-V: **(9)**

Base band Shaping for data transmission: Discrete PAM signals, Inter-symbol interference (ISI) Nyquist criterion for distortion-less Base band binary transmission, correlative coding, Eye-pattern, transmission,

correlative coding, Eye-patterns Baseband Mary PAM system, Adoptive Equalization, The zero forcing algorithm, The LMA algorithm

TEXTBOOKS:

1. Alberto Leon–Garcia and Indra Widjaja: Communication Networks-Fundamental Concepts and Key architectures,2nd Edition,TataMcGrawHill,2006.

2. Simon Haykin: Digital Communication, Wiley India,2007.

REFERENCEBOOK:

1. John G. Proakis: Digital Communications, 3rd Edition, McGraw Hill,2008

2. Leon W. Couch: Analog/Digital Communication, 5th Edition, PHI,2008

Laboratory-I:

PGETX106P	Advanced Digital Signal Processing

Any EIGHT practicals are to be conducted based on the syllabus of Advanced Digital Signal Processing [PGETX101T]

Laboratory-II:

PGETX107P	Advanced Embedded System Design

Any EIGHT practicals are to be conducted based on the syllabus of Advanced Embedded System Design [PGETX103T]

R.T.M. Nagpur University
Scheme of Examination for
M. Tech. (Electronics) Second Semester

PGETX201T	Digital System Modeling and Simulation

Course Objectives:

1. To study combinational and Sequential circuit designs.
2. To study analysis using State Machines.
3. To study synchronous design methodologies.
4. To study the signal analysis using Logic Analyzers.

Course Outcome: After completing this course students shall be able to:

1. Design of combinational & sequential circuit.
2. Implementation of digital system.
3. Experimentation on Hardware /Software co-design.

UNIT I: (8)

DESIGN FOR: Testability, Estimating Digital System Reliability, Transmission lines, Reflections and Transmissions

UNIT II: COMBINATIONAL CIRCUIT DESIGN: (9)

Timing hazards, Static hazards using Maps, Dynamic hazards, Designing hazards free circuits, Barrel shifter design, Simple Floating point encoder, SEQUENTIAL LOGIC DESIGN: Timing parameter for different latches- D Latch (Edge Triggered D Latch) Master slave JK flip flop, Edge triggered JK flip flop

UNIT III: CLOCKED SYNCHRONOUS STATE MACHINE ANALYSIS: (9)

Clocked Synchronous state Machine Design, Designing state machine using state diagram, State machine synthesis using transition lists , State machine design examples, Decomposing State machine, feedback Sequential Circuits, feedback Sequential Circuit design

UNIT IV: SYNCHRONOUS DESIGN METHODOLOGY: (9)

Synchronous system structure, Impediment to Synchronous Design, Synchronizer failure and Meta-stability

UNIT V: TIMINGS: (9)

ROM timings, Static RAM timing, Synchronous Static RAM and it's timing, Dynamic RAM timing, Complex Programmable Logic Devices, Logic Analyzer Basic Architecture, Internal structure, Data display, Setup and Control, Clocking and Sampling

TEXT BOOKS:

1. Digital System modeling & simulation, Claudius Ptolemaeus, Editor,

REFERENCE BOOKS:

1. Digital Design Principles and Practices (Edition II) John F. Wakerly PH Inc.
2. Microcomputer Handbook Mc Crindle- Collins Publications

PGETX202T	High Performance Communication Networks

Course Objectives:

1. To study the concept of Layered Architectures.
2. To study the principles of wired and wireless networks.
3. To study the principles of Mobile Ad-hoc Networks.
4. To study the different TCP/IP based networks.
5. To study High Performance networks based WiMax and UWB.

Course Outcome: By the end of course, the students shall be able to

1. Understand the requirement of theoretical & practical aspect of computer network.
2. Describe various protocols used in High Performance based network.
3. Design MANET based applications.

UNIT I: Introduction: (8)

Overview of Communication Networks: Telephone networks, computer networks, cable television networks, wireless networks, networking principles, digitalization, network externalities, service integration; Network Services and Layered Architecture: Traffic characterization and QoS, network services, network elements, network mechanisms, layered architecture, network bottlenecks.

UNIT II: Broadband Networks Introduction: (8)

Multihop wireless broadband networks, mesh networks, MANET importance of routing protocols, classification of routing protocols in MANET, routing metrics, packet scheduling algorithms, admission control mechanism

UNIT III: Internet and TCP / IP Networks Internet: (10)

Internet protocol, technology trends in IP networks, IP packet communications in mobile communication networks; TCP and UDP, Internet success and limitation, performance of TCP/ IP networks; Circuits Switched Networks: SONET, DWDM, fiber to home, DSL, intelligent network (IN) scheme, comparison with conventional systems, merits of the IN scheme, CATV and layered network, services over CATV.

UNIT IV: ATM Networks Introduction: (9)

ATM reference model, addressing, signalling, routing, ATM Adaptation Layer (AAL), traffic classes, traffic management and quality of service, traffic descriptor, traffic shaping, management and control, traffic and congestion control, network status monitoring and control, user/ network signalling, internetworking with ATM, IP over ATM, multiprotocol over ATM.

UNIT V: High Performance Networks Introduction: (9)

WiMAX overview, competing technologies, overview of the physical layer, PMP mode, mesh mode, multihop relay mode; Introduction: UWB overview, time hopping UWB, direct sequence UWB, multiband UWB; Introduction: LTE and LTE, A overview, system model, specifications, frame structure, comparison with broadband technologies.

TEXT BOOKS:

1. Amitabha Ghosh and Rapeepat Ratasuk, "Essentials ofLTE and LTE-A", Cambridge University, 2011.

2. David Tung Chong Wong, Peng-Yong Kong, Ying-Chang Liang, Kee Chaing Chua and Jon W. Mark, "Wireless Broadband Networks", John Wiley and Sons, 2

REFERENCE BOOKS:

1. Jean Warland and Pravin Varaiya, "High Performance Communication Networks", 2nd Edition, Harcourt and Morgan Kanffman Publishers, London, 2008.

2. Leon Gracia and Widjaja, "Communication Networks", Tata McGraw Hill, 2008.

3. Lumit Kasera and Pankaj Sethi, "ATM Networks: Concepts and Protocols", Tata McGraw Hill, 2007.

4. Jeffrey G. Andrews, Arunabha Ghosh and Rias Muhamed, "Fundamentals of WiMAX Understanding Broadband Wireless Networking", Prentice Hall of India, 2008.

PGETX203T	Advanced System Design

Course Objectives:

1. To study the concept of System Modelling.
2. To study different system design simulation softwares.
3. To study different Continuous and Discrete Time Systems.
4. To study discrete time analysis using Z-Transforms.
5. To study design of Linear and Non-Linear systems.

Course Outcome: By the end of course, the students shall be able to

1. Demonstrate system modelling.
2. Simulate different linear and non-linear systems.

UNIT I: **(8)**

Introduction – System modelling, Concept of a Model and Model building, Model classification, Identification, Simulation softwares

UNIT II:
(9)

Continuous Time and Discrete Time Systems – Continuous-Time Linear systems, simple electrical circuits, Laplace transform, transfer functions, state-space model

UNIT III: **(9)**

Discrete time systems, Z-transform, a-b tracking system, Feedback system, stability, controllability and observability. Nonlinear System Analysis and Modeling – Mathematical models for nonlinear systems, phase trajectory and local linearization, system stability, controllability and observability, Input-output mapping and system invertibility, Linearization and linearizability, nonlinear system modeling and simulation

UNIT IV: **(9)**

Computer Simulation – Numeric integration, state space simulation techniques, simulation of discrete-time systems, digital simulation languages, Robotic Systems and Automation – Modeling of robot, control of robots, modeling of mobile robots and control, applications

UNIT V: **(9)**

Design and analysis of Simulation Experiments – Design of simulation Experiments, analysis of simulation experiments, variance reduction techniques. Digital Control systems – Basic Digital Control system, design approaches, implementation

TEXT BOOKS:

1. Naim A Kheir, System Modeling and Computer Simulation, Marcel Dekker Inc, 19962.

2. Modeling & Simulation Using Matlab-Dr.Sailendra Jain(Wiley)

REFERENCE BOOKS:

1. Louis Birta, Gilbert Arbez, Modeling and Simulation, Springer

2. Donald Boyo, System Analysis and Modeling, Academic Press, 2001.

3. System Modeling and Simulation –Frank L.Severance(Wiley)

4. I. Mitrani, Simulation Techniques for Discrete Event Systems, Cambridge

5. Theory of Modeling and Simulation, 2nd Edition, Zeigler & Kim & Praehofer, 2000, Academic Press, Elsevier

Elective-III (Discipline Specific):

PGETX204/1T	Fault Tolerance in Digital Circuits

Course Objectives:

1. To study modelling at logic and register level.
2. To study the detection of Hazards.
3. To study different fault detection techniques.
4. To study different fault simulation techniques.
5. To study fundamentals of data compression.

Course Outcome: By the end of course, the students shall be able to

1. Demonstrate Logic Level and Register Level Modelling.
2. Identify efficient fault detection technique.
3. Simulate the faults in an application.

UNIT I: **(9)**

Modeling: Basic Concept, Functional modeling at the logic level, Functional models at the register level, Structural models, Level of modeling, Type of simulation, unknown logic value, compiled simulation, Event-driven simulation and Hazard Detection.

UNIT II: **(9)**

Logical fault models, Fault detection and redundancy, Fault equivalence and fault location, Fault Dominance, Single stuck-fault models, multiple stuck fault model, stuck RTL variables, Fault variables. Testing for Single Stuck fault and Bridging fault.

UNIT III: **(9)**

General fault simulation techniques, Serial Fault simulation, Parallel fault simulation, Deductive fault simulation, Concurrent fault simulation, Fault simulation for combinational circuits, Fault sampling, Statistical fault analysis.

UNIT IV: **(8)**

General aspects of compression techniques, ones- count compression, transition – count compression, Parity – check compression, Syndrome testing and Signature Analysis Basic concepts

UNIT V: **(9)**

Multiple – Bit Errors, Checking circuits and self checking, self – checking checkers, Parity– check function, totally self-checking m/n code checkers, totally self-checking equality checkers, Self-checking Berger code

checkers and self checking combinational circuits. Built In Self Test, Self-testing circuits for systems, memory & processor testing, PLA testing, Automatic test pattern generation and Boundary Scan Testing JTAG

TEXT BOOKS:

1. Self-Checking and Fault-Tolerant Digital Design, 1st Edition,P Lala

2. Israel Koren and C. Mani Krishna, Fault-Tolerant Systems, Morgan-Kaufman Publishers, 2007

REFERENCES BOOKS:

1. D. Siewiorek and R. Swarz, Reliable Computer Systems: Design and Evaluation, 3rd edition, AK Peters, 1998.

2. D. K. Pradhan, editor, Fault-Tolerant Computer System Design, Prentice-Hall, 1996.

3. B.W. Johnson, Design and Analysis of Fault-Tolerant Digital Systems, Addison Wesley, 1989.

4. Michael L. Bushnell and Vishwani D. Agrawal, Essentials of Electronic Testing for Digital, Memory, and Mixed-Signal VLSI Circuits, by Springer 2000.

Elective-III (Discipline Specific):

PGETX204/2T	Advanced Digital Image Processing

Course Objectives:

1. To understand the techniques for image enhancement.
2. To understand techniques for image segmentation.
3. To understand the techniques for compression.

Course Outcome: By the end of the course, the students shall be able

1. To be able to design and implement image enhancement schemes.
2. To be able to design and implement compression schemes.
3. To be able to design and implement restoration schemes.
4. To be able to design and implement segmentation schemes.

UNIT I: IMAGE REPRESENTATION (8)

Image representation-Image Basis Functions, Two dimensional DFT, Discrete Cosine Transform, Walsh-Hadamard transform, Wavelet transform, Principal component analysis.

UNIT II: IMAGE ENHANCEMENT AND RESTORATION (9)

Gray level transformation techniques- Spatial domain techniques, Half toning, Median filtering, contrast stretching, Histogram Equalization, Frequency domain techniques, Weiner filtering, Homomorphic filtering, PSFs for different forms of blur, noise models, color image processing.

UNIT III: IMAGE SEGMENTATION (9)

Segmentation, Similarity and dissimilarity methods, Thresholding, Edge based and Region based methods, Hough transform, Morphological operations, Clustering methods.

UNIT IV: IMAGE COMPRESSION (9)

Source coding techniques, Run length coding, Shannon-Fano coding, Huffman coding, Arithmetic coding, LZW coding, Transform and Predictive compression methods, Vector quantization, case studies, JPEG, MPEG.

UNIT V: SIMULATION (9)

Implementation of Image processing algorithms, Image Enhancement, Restoration, Segmentation, Coding techniques, Applications.

TEXT BOOKS:

1. Gonzalez R. C. and Woods R.E., “Digital Image Processing”, 3rd Edition, Prentice-Hall, 2008.

2. William K. Pratt, “Digital Image Processing”, John Wiley, 4th Edition, 2007.

REFERENCE BOOKS:

1. Jain A.K., “Fundamentals of Digital Image Processing”, PHI Learning Private Ltd., 1989.

2. Sonka M, “Image Processing, Analysis and Machine Vision”, Vikas Publishing Home (Thomson) 2001.

3. Schalkoff R.J., “Digital Image Processing & Computer Vision”, John Wiley & Sons, 1992.

4. Richard O. Duda, Peter E. Hart and David G. Stork., “Pattern Classification”, Wiley, 2001.

5. J.W. Woods, "Multidimensional Signal, Image, Video Processing and Coding", 2nd Edition,Academic Press, 2012.

Elective-III (Discipline Specific):

PGETX204/3T	Mobile Communication

Course Objectives:

1. To understand the basic knowledge about the generation of mobile communication.
2. To familiarize with the recent trends in the field of wireless communication
3. To study and relate the different types of mobile communication system.
4. To study architecture of mobile communication.
5. To get knowledge about application's of mobile communication

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Course Outcome: At the end of the course, the student should be able to:

1. Understand the Cellular Systems
2. Know the concept of Switching systems
3. Understand the concept of Base station subsystems

UNIT I: Introduction to Cellular Mobile Systems (8)

A basic cellular system, performance criteria, uniqueness of mobile environment, operation of cellular systems, planning a cellular system, analog and digital cellular systems Elements of Cellular radio system design, concept of frequency reuse channels, co-channel interference reduction factor, desired C/I from a normal case in an omni directional antenna system, cell splitting

UNIT II: Cell coverage for Signal and Traffic (9)

General introduction, mobile point to point mode, radio propagation characteristics: models for path loss, shadowing and multipath fading, propagation over water or flat open area, foliage loss, propagation in near distance, long distance propagation, cell site, antenna heights and signal coverage cells, mobile to mobile propagation

UNIT III: Frequency Management, Channel Assignment and Handoff (9)

Frequency management, fixed channel assignment, non fixed channel assignment, traffic and channel assignment, why handoff, types of handoff and their characteristics, handoff analysis

UNIT IV: Multiple Access Techniques (9)

FDMA/TDMA – CDMA, FDM/TDM Cellular systems, cellular CDMA, soft capacity, Earlang capacity comparison of FDM/TDM systems and Cellular CDMA GSM architecture, mobile management, network signaling, frequency allocation and control

UNIT V: (9)

WLAN, WMAX and its standards, IEE802.16E, VIBRO, Bluetooth and its stack layers, OFDMA, WMLA, IRDA

TEXT BOOKS:

1. T.S.Rappaport, Wireless Communications: Principles and Practice, Second edition, PHI,2003

2. G.L. Stuber, Principles of Mobile Communications, Kluwer Academic Press

REFERENCE BOOKS:

1. Dr Kamilo Feher, Wireless and Digital Communications, PHI

2. R.Blake , Wireless Communication Technology, Thomas Delmar, 2003

Elective-III (Discipline Specific):

PGETX204/4T	Advanced Communication Technologies

Course Objectives:

1. To study the basic concept of communication and different modulation system based on basic parameters.
2. To study the AM, FM, PM process.
3. To Study fundamental processes of Digital Modulation Techniques.
4. To study different coding techniques.

Course Outcome: At the end of the course, the student should be able to:

1. Compare different modulation techniques of Generation of FM
2. Explain the working principles of basic building blocks of a digital communication system.
3. Describe digital modulation techniques.
4. Model digital communication systems using appropriate mathematical techniques.

UNIT I: Elements of Communication System: (9)

The elements of a communication system, origin of noise and its effect, importance of SNR in system design, Basic principle of linear (AM) modulation, Generation of AM waves, Demodulation of AM wave, Basic principle of nonlinear (FM, PM) modulation, Generation of FM waves, Demodulation of FM waves.

UNIT II: (9)

Sampling theorem, sampling rate, impulse sampling, reconstruction from samples, Aliasing, Analog pulse modulation-PAM (natural & flat topped sampling), PWM, PPM, Basic concept of Pulse code modulation, Block diagram of PCM and DPCM, Concept of Quantization & Quantization error, Uniform quantizer, Non-uniform quantizer, A-law and m -law

UNIT III: Digital Transmission: (8)

Multiplexing-TDM, FDM, Encoding, coding efficiency, Line coding & properties, NRZ & RZ, AMI, Manchester coding, Base band pulse transmission, Matched filter, error rate due to noise, ISI, Raised cosine function, Nyquist criterion for distortion-less base band binary transmission, Eye pattern, Signal power in binary digital signal.

UNIT IV: Digital Carrier Modulation & Demodulation Technique: (9)

Bit rate, Baud rate, Information capacity, Shanon's limit, M-ary encoding, Introduction to the different digital modulation techniques-ASK ,FSK, PSK, BPSK, QPSK, mention of 8BPSK, 16 BPSK, Introduction to QAM, basic of 8 QAM, 16 QAM, Basic concept of Delta modulating, Adaptive delta modulation, Introduction to the concept DPCM, Basic concept of spread spectrum modulation.

UNIT V: Introduction to Coding Theory: (9)

Introduction, News value & Information content, Entropy, Mutual information, Information rate, Shanon-Fano algorithm for encoding, Shanon's theorem- source coding theorem, Channel coding theorem, Information capacity theorem, Basic principle of Error control & coding.

Numerical problems to be solved in the class.

TEXT BOOKS:

1. An Introduction to Analog and Digital communication, Simon Haykin, Wiely India.

2. Analog communication system, P. Chakrabarti, Dhanpat Rai & Co.

3. Principle of digital communication, P. Chakrabarti, Dhanpat Rai & Co.

4. Modern Digital and Analog Communication systems, B.P. Lathi, Oxford University Press

REFERENCE BOOKS:

1. Digital and Analog communication Systems, Leon W Couch II, Pearson Education Asia.

Foundation-I

Laboratory-I:

PGETX206P	Digital System Modeling and Simulation

Any EIGHT practicals are to be conducted based on the syllabus of Digital System Modeling and Simulation [PGETX201T]

Laboratory-II:

PGETX207P	Advanced System Design

Any EIGHT practicals are to be conducted based on the syllabus of Advanced System Design [PGETX203T]

R.T.M. Nagpur University
Scheme of Examination for
M. Tech. (Electronics) Third Semester

Foundation-II

R.T.M. Nagpur University
Scheme of Examination for
M. Tech. (Electronics) Third Semester

Elective-IV (open)